than in detailed knowledge of how the techniques work, scientists use indirect measures to answer the epistemic challenge. Chapter 4 will focus on three such indirect measures used by cell biologists – the determinateness and repeatability of the resulting evidence, consilience of evidence from multiple techniques, and the coherence of the evidence with plausible accounts of the mechanism under study.

In Chapters 5 and 6 I turn to how these new techniques were deployed to better understand cell mechanisms.[8] Chapter 5 concentrates on one laboratory located at the Rockefeller Institute that conducted many of the pioneering inquiries. The initial focus of this laboratory was cancer. Albert Claude centrifuged tumor cells in an attempt to find within them particles involved in the transmission of cancer. When the particles he discovered turned out not to be unique to cancer cells, he shifted his attention to studying those isolated from normal cells. Collaborating with chemists, he identified the chemical reactions associated with centrifuged fractions containing those particles. In collaboration with Keith Porter, he also began employing electron microscopy to compare the particles in the fractions with components of intact cells to determine their origins. A major accomplishment of this research was to demonstrate that a fraction that was highly specific for a certain cell organelle – the mitochondrion – contained the critical enzymes involved in cellular respiration. Mitochondria were dubbed the power plants of the cell, and they became a focus of the analytic powers of cell biologists.

Chapter 6 describes how in the 1950s and 1960s a growing cadre of researchers adopted the techniques of electron microscopy and cell fractionation and pursued the project of explicating the mechanisms operative in the cell cytoplasm. Figure 1.1 is a drawing portraying the organelles known to populate the cell that is representative of those offered by cell biologists based on the electron micrographs produced in the 1950s. Cell biologists and biochemists both contributed to increasingly fine-grained accounts of the structures within mitochondria and their roles in biochemical operations. A crowning achievement was the discovery that certain key enzymes were embedded in the inner membrane of the mitochondrion so as to spatially and temporally organize the reactions involved in electron transport and oxidative phosphorylation. The work with mitochondria provided an exemplar (in Kuhn's sense) of how to link functions with organelles that became a model

[8] Treating the development of new instruments and research techniques separately from their utilization in developing new knowledge is artificial because the investigators were putting their techniques to use to secure information about cell mechanisms as they were developing them. I have discussed them separately so as to do justice to the different epistemic issues involved in developing the techniques and using them to understand mechanisms.